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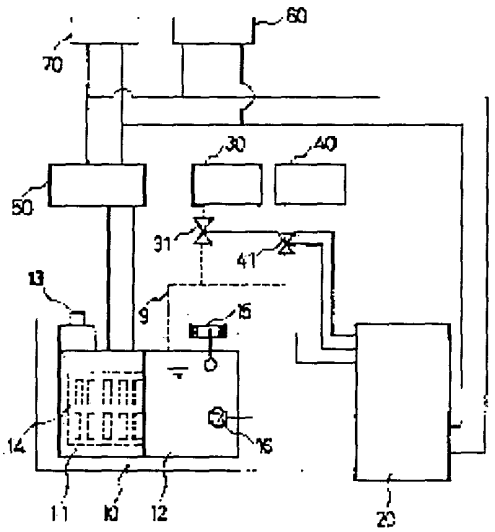
(54) OPERATION CONTROL METHOD AND APPARATUS FOR LIQUID FUEL BATTERY

(57)Abstract:
PURPOSE: To enable automatic long-term operation of a small-capacity liquid fuel cell with the use of no manpower.
CONSTITUTION: A fuel tank 12 is additionally provided to a fuel battery body 11 of a liquid fuel battery 10 in which unit cells are plurally laminated with separators interposed therebetween and liquid fuel is used as direct fuel. The fuel temperature inside the fuel tank 12 is metered by a temperature gauge 16 in each specified unit of time. When the liquid temperature exceeds a value set beforehand, purified water in a water tank 40 is supplied to the fuel tank 12. When the liquid temperature falls below a lower limit, liquid fuel in a preliminary fuel tank 30 is supplied to the fuel tank 12. By causing control to be made through use of the liquid temperature only, the apparatus is simplified and the operation control under no manpower becomes possible.



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Translation of JP-05-258760

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CLAIMS

[Claim(s)]
[Claim 1] It is the operation-control method of the liquid fuel cell which carries out the laminating of two or more unit cells which consist of an oxidizer pole, a fuel electrode, and an electrolyte through separator, and uses liquid fuel as direct fuel. As opposed to the setting operating temperature limit which measured the fuel temperature in the fuel tank attached to the fuel cell main part, and was set up beforehand The operation-control method of the liquid fuel cell characterized by maintaining fuel concentration almost uniformly and operating by supplying a diluent to a fuel tank when a measurement value exceeds the upper limit, and supplying liquid fuel to a fuel tank when a measurement value turns into below a lower limit.
[Claim 2] The operation-control method of the liquid fuel cell according to claim 1 characterized by for liquid fuel being the inner fluid material of at least 1 although chosen out of a methanol, formalin, formic acid, and a hydrazine, and a diluent being "pure water."
[Claim 3] It is the control device of the liquid fuel cell which carries out the laminating of two or more unit cells which consist of an oxidizer pole, a fuel electrode, and an electrolyte through separator, and uses liquid fuel as direct fuel. A thermometry means to measure the fuel temperature in the fuel tank attached to the fuel cell main part, As opposed to the operating temperature limit which has a reserve liquid fuel tank and a diluent tank at least, and set them up beforehand A means to supply the diluent in a diluent tank to a fuel tank when the measurement value of this thermometry means exceeds the upper limit, The control device of the liquid fuel cell characterized by having further a means to supply the liquid fuel in a contingency-fuel tank to a fuel tank when a measurement value turns into below a lower limit.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] About the operation-control method of a liquid fuel cell, and equipment, although especially this invention is few capacity, it relates to the operation-control method of a liquid fuel cell and equipment which enabled continuation operation in the state of full automation over the long time.
[0002]
[A Prior art and the technical problem which should be solved] Liquid fuel, such as a methanol and HIDORASHIN, is used as a negative-electrode active substance, air is used as a positive active material, and the practical use as a power supply for communication is expected as a power supply for remote districts from reasons with structure simple [the liquid fuel cell using a potassium hydroxide or a sulfuric acid as an electrolyte]. However, about continuing for a long time and carrying out the operation control of the liquid fuel cell of few capacity, it has the characteristic technical problem.
[0003] Namely, as shown in drawing, while drawing 5 is explanatory drawing showing the cell system in the liquid fuel cell of the conventional 100W class and manufacturing the main part of a cell, and a fuel tank as a thing of another object In order to keep constant the service condition from cold during starting to steady operation, many devices, i.e., the heater for temperature ups of liquid fuel, and the radiator for liquid cooling are begun. as a device for control Auxiliary devices, such as a thermometric element, a concentration detector, a tank liquid level detector, a solenoid valve, and a controller, or the pump for a fuel transfer is needed, and external power is also needed simultaneously.
[0004] As the fundamental control technique, fuel concentration is measured with a concentration meter, and a thermometer detects temperature separately, and fuel concentration is controlled by performing supply of fuel or supply of water alternatively based on both value. However, though a concentration meter is generally complicated and it is expensive, the result which lacks in reliability and is not necessarily satisfied is not obtained.
[0005] This invention persons actually did fixed time operation of the above equipment in the state of 100W of effective outputs, and when they measured power required for operation of the auxiliary device at that time, they had amounted to about 25W (refer to the term of the conventional-type equipment in Table 1). Furthermore, by repeating an

experiment, in the operating method using the above conventional auxiliary devices, no matter the effective output of the main part of a cell might not be proportional to auxiliary power required for operation of an auxiliary device but it might be what small-scale operation system, that fixed auxiliary power is also needed has perceived. Therefore, when it was going to use a liquid fuel cell as a small capacity power supply, the rate of the reactive power (power consumed within a system in order to operate a cell system) to effective power found the system and bird clapper which increase rapidly and are not realized economically.

[0006] Moreover, since it was the control system which combined many meanses, it was impossible to have operated in the state under long days uninhabited as a matter of fact, and it was also still more difficult to consider as the power supply which completely became independent, and to use it from surely needing an external power, in using a heater. Furthermore, in J.Electrochem.Soc., Vol.18.No.9, and P1523 (1971), it is conventionally based on K.J.Cathro as an example of fuel concentration control of a methanol-air fuel cell. "Fuel Cintrol in Methanol-Air and Formaldehyde-Air Fuel Cell System" It is entitled and discussed. In this reference, two methods, i.e., the direct concentration detecting method of (1) cyclic Volta MUMETORI application, (2) load currents, and the two methods of the Faraday method application burn-out-fuel calculation are described. which method -- also setting -- from the outside -- electrochemical -- a certain reaction -- it is necessary to give -- equipment -- complicated -- becoming -- moreover, temperature -- the point for which it depends greatly has been the technical problem which should be conquered

[0007] since it is above, a liquid fuel cell is expected as a power supply for a small output in a remote district, and are bur now -- the actual condition has not arrived at the region of practical use The purpose of this invention solves un-arranging [which the above conventional liquid fuel cells have], and aims at offering no perfect automated-system-operation-preparing, the small capacity of continuous running which made - non-performed maintenance possible, and a become [independent] type fuel cell for a long time.

[0008]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem and to attain the purpose, this invention persons inquired wholeheartedly about the system in which automated system operation is possible, without minimum-izing reactive power by the simplification (abolition of parts, or formation of small capacity) of the auxiliary device for the operation control of a liquid fuel cell, and being influenced by change of the outside air temperature by the four seasons.

[0009] Consequently, about simplification of an auxiliary device, and minimum-ization of the power consumed for cell itself at the time of fuel cell operation, it attained by changing to the operation-control method only by fuel temperature to the fuel concentration control which is the main element of cell operation. Specifically, unify a fuel cell main part and a fuel tank, and the solution temperature near the chemical reaction state at the time of power generation is measured by the fixed time interval. In order to raise and carry out the temperature up of the fuel concentration of a cell attached tank at a low case rather than the lower limit to which measurement temperature set the measurement value as compared with the setting operating temperature limit defined beforehand, fuel is supplied from the contingency-fuel tank of another installation. When measurement temperature becomes higher than the upper limit of setting temperature, in order to make the fuel concentration

of a cell attached tank lower and lower, a series of control which supplies pure water from the diluent tank of another another ** was made to perform concentration control and a fuel temperature control simultaneously. By the warp, as a result of being able to omit the during-starting heater which was required of the conventional method, a radiator, a fuel cooling fan, a water cycle pump, a thermo sensor, and various kinds of control units and uniting an attached fuel tank with the main part of a cell still as mentioned above, or it was between the fuel tank and the main part of a cell, the fuel feed pump in a fuel tank could also be omitted, and the small cell system which has the performance stabilized rather than the simple and conventional concentration control system was able to be built.

[0010]

[Example] Hereafter, based on an example, this invention is explained more to a detail. Drawing 1 shows the composition of one example of the liquid fuel cell for carrying out this invention. 10 is an acid electrolytic-type methanol-air fuel cell with a small capacity of 1-2W. The fuel cell main part 11 which carried out the laminating of two or more unit cells which consist of an oxidizer pole, a fuel electrode, and an electrolyte through separator, and the fuel tank 12 in which the methanol which is fuel was held are constituted by one. Air is supplied to the oxidizer pole of the main part 11 of a cell by the air supply fan 13 who installed in the cell case upper part, and the methanol in a fuel tank 12 is supplied to a fuel electrode by natural circulation through the slot 14 of each cell.

[0011] The float sensor 15 and thermometer 16 which are a level gage are attached in the fuel tank 12, and the measurement information on the float sensor 15 and a thermometer 16 is sent to a controller 20. it dissociates in a fuel cell 10 and the contingency-fuel tank 30 and a water tank 40 prepare -- having -- the contingency-fuel tank 30 -- the methanol as fuel -- and the pure water as a diluent is contained by the water tank 40 The contingency-fuel tank 30 and the water tank 40 are connected to a fuel tank 12 through a duct 50, and solenoid valves 31 and 41 are infixed in the middle of a duct. In these solenoid valves 31 and 41, the signal from a controller performs switching action and fuel or purity is supplied to a fuel tank 12.

[0012] Moreover, it serves both as the pressure up of voltage, and stabilization in this example. It supposes that the pressure up of the voltage is carried out with DC to DC converter 50 more than constant value, and after charging a battery 60, it is made to carry out an electric power supply to load side 70. A controller 20 emits the signal which makes a solenoid valve 41 open, when it is over the upper limit of the temperature requirement defined beforehand, while measuring the signal from a thermometer 16 for every predetermined-time interval, and it emits the signal which makes a solenoid valve 31 open to a low case rather than a lower limit. Furthermore, the signal from the float sensor 15 is received, and when set to the upper limit level which the oil level of a fuel tank 12 defined beforehand, the signal which makes a solenoid valve 31 or 41 close is emitted.

[0013] How to control operation of the fuel cell by this invention using above equipment is explained. In this kind of fuel cell, if power generation starts and time passes, the methanol concentration in a fuel tank 12 will fall gradually, the chemical reaction in a cell will decrease, and the solution temperature in a fuel tank will fall. When solution temperature becomes a low value from the lower limit defined beforehand, a methanol is supplied from the contingency-fuel tank 30. The methanol concentration in a fuel tank goes up by that cause, and solution temperature also rises. When it becomes more than the upper limit to which solution temperature was set beforehand, water is supplied from a water tank 40.

While solution temperature dives temporarily with this water, the methanol concentration in a tank 12 is lowered and too much chemical reaction is suppressed. Therefore, according to the operation-control method of this invention, it becomes possible to hold the concentration and temperature of fuel in the predetermined numerical range simultaneously.

[0014] Next, the example at the time of performing the operation-control method of this invention using the system shown in drawing 1 is described. For the used fuel cell 10, it is 1W of effective outputs, and a platinum-catalyst electrode, electrolytes are eight cells using a cation exchange membrane (Nafion and Du Pont) and a styrene sulfonic acid, and the number of cell laminatings is DC/DC in 1.6-3.2 volts of the cell output voltage. It experimented as specification which carries out a pressure up to 14 volts through a converter 50.

[0015] On the occasion of the cell start up, 42 degrees C (solution temperature temperature of a fuel tank 12) of cell temperature were set up. Henceforth, thermometry was carried out every 60 minutes, when solution temperature T was T> 60 degrees C, water was supplied from the water tank (ordinary temperature), and the instructions which pour in a methanol from a reserve tank 30 (ordinary temperature) were emitted from the controller 20 at the time of T<=60 degree C. When the oil-level level of the fuel tank 12 after water supply or methanol pouring was detected and predetermined level was reached, the signal which closes a solenoid valve 41 or 31 was emitted. After starting, at the measurement (1st time, 2nd time, and 3rd time) time, since it was T<=60 degree C, the result poured in the methanol. At the 4th measurement time, since it had become T> 60 degrees C, water was poured in. The cycle of two methanols and one water was repeated after it. Average solution temperature was held as a result at T=54+-6 degree C. Moreover, it is fixed and converter output voltage is [about 14 volts and] ******.

[0016] The reactive power described above in that case was shown in the term of the "this equipment" of Table 1. Although it is difficult to compare as it is since both effective output is large and conventional-type equipment differs from this equipment in Table 1 although reactive power becomes 10 or more times to effective power and operation is difficult practically, supposing it constitutes a 1W class cell from a conventional method, since the item of (5) - (9) of front Naka is comparatively linked to the capacity of a cell and (1) - (4) becomes about 1 law regardless of the capacity of a cell When based on this invention, an execute permission and a bird clapper can guess easily enough (in addition, the power for a during-starting heater of (10) is removed on calculation).

[0017]

[Table 1]

[0018] Next, the same operation control was performed using the same system under different open air conditions. One carried out continuation operation of another under about 150-hour uninhabited under conditions of 40 degrees C of outside air temperature under conditions of -2 degrees C of outside air temperature. The solution temperature change and converter output change at that time were shown in drawing 2 (-2 degrees C of outside air temperature), and drawing 3 (40 degrees C of outside air temperature). Converter output voltage is indicated to be solution temperature change which can be

boiled and set. As shown in drawing, in any case, the output voltage of simultaneously regularity was shown for the whole term.
[0019] furthermore, the bottom of natural environment -- and the same equipment was installed under uninhabited and the continuation experiment over 4400 hours was conducted The result is shown in drawing 4 . As shown in drawing, the performance expected in cell temperature (solution temperature) and output voltage was obtained.
[0020]
[Effect of the Invention] Since it changes to the concentration control which was performed as an operation-control element of the conventional fuel cell and which lacks in reliability though it is complicated and is expensive in this invention and was made to perform control only by solution temperature so that clearly also from the above experimental result, simplification of equipment was attained and the operation control under uninhabited became possible.

[Translation done.]